Occupational Outlook Quarterly

In this issue:

Starting and Managing a Small Business
Occupations in Space Exploration
Employment Outlook for Over-the-Road Truckdrivers

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UNITED STATES DEPARTMENT OF LABOR
Bureau of Labor Statistics
in cooperation with
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Occupational Outlook Quarterly

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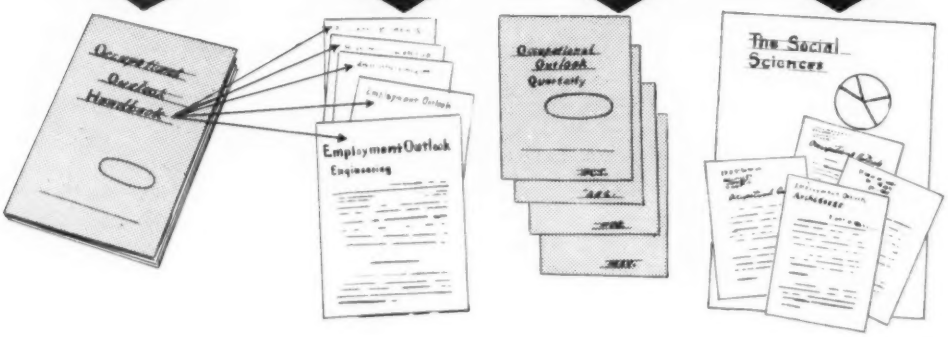

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STARTING AND MANAGING A SMALL BUSINESS

by Wendell O. Metcalf*

One group of workers most often overlooked in occupational literature are the owners of small businesses. Yet, it is estimated that more than 7 million Americans are engaged in managing their own business firms. Obviously, a great many young persons now in school will eventually become proprietors of retail stores, repair shops, restaurants, small manufacturing plants, and many other types of business establishments. Few people leaving high school or college will have either the technical knowledge or the financial resources necessary to move directly into the ownership and management of a business firm. Nevertheless, it is important for the young person who has a long-term ambition to "work for himself" to know what problems he will have to face and resolve before attaining his goal, and what steps he might take immediately to prepare himself for his work.

The great majority of all businesses, large and small, are retail and service establishments. Manufacturers, wholesalers, contractors, and other types of firms account for a relatively small number of business firms, although some individual concerns, especially in manufacturing, are very large and conduct a much greater than average volume of business. Small retail businesses, defined by the Small Business Administration as those with annual sales of less than $1 million, account for about 19 out of 20 retail firms. Since most businesses are small retail and service firms, this article is directed mainly to the problems of setting up this type of business.

Some Important Considerations

The man who becomes owner of a business firm will be in a much different situation than the wage or salary worker. He will be top man. He can't be fired. Running his own business will bring a sense of independence--an opportunity to use his own ideas. It will mean a chance for higher income because he can collect a salary plus a profit or return on his investment. He will experience a pride in ownership, and he will, if successful, have the great satisfaction of building a valuable investment.

By being top man, the new owner can adopt new ideas quickly. Since his enterprise undoubtedly will be a small business--at least in the beginning--he will have no large, unwieldy work force to retrain each time he wants to try something new. If his new idea doesn't work, he can also drop it quickly. This opportunity for flexibility will be one of his greatest assets.

These are some of the advantages and pleasures of operating a business. But there are a number of disadvantages. A businessman who has employees must meet a payroll week after week. He must have money to pay creditors--the man who sells him goods or materials; the dealer who furnishes fixtures and equipment; the landlord, if he rents, or the mortgageholder if he is buying his place of business; the publisher running his advertisements; the tax collector; and many others. He must accept sole responsibility for all final decisions. Wrong judgment on his part can result in losses not only to himself but, possibly, to his employees, creditors, and customers as well. Moreover, he alone must meet adverse situations caused by circumstances beyond his control, such as depressed economic conditions or strong competition.

To overcome these disadvantages and keep a business profitable will mean long hours of hard work. Invariably,

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those who go into business for themselves will work longer hours than they did when they were working for someone else; at least, this will be necessary in the beginning.

Then, while the small businessman in theory is his own boss, in practice it is not entirely so. No matter what business he chooses--whether a manufacturing, wholesaling, retailing, or service business--he must satisfy his customers. His creditors and his competitors will dictate to him. Health authorities and insurance people will see that he meets certain standards and follows certain regulations. He will have to abide by wage and hour laws and keep records in accordance with the requirements of those laws and of the tax system.

Since the success of a small business depends largely on the prospective owner's abilities, it is important that he rate himself objectively from the viewpoint of operating his own business, appraising his strong points and weak points. Some of the traits considered important for the person operating his own business are initiative, leadership, organizing ability, sincerity, energy,

Selling ability is one of the most important requirements for success in small business

perseverance, ability to work well with others, willingness to assume responsibility, and ability to make quick and accurate decisions. The prospective small business owner will do well to recognize his weak points before opening a business. Perhaps he can compensate for them by engaging the right employees or obtaining associates whose strong points offset his weak ones. If he recognizes that he is weak in salesmanship, for example, he should cover that deficiency by employing the best sales talent he can afford. But if one is weak in too many of the traits needed for managing a business, he should not make the venture.

Deciding on a Type of Business

Now, what business should one choose? For many, this is no problem. Others are constantly seeking an answer to this question from counselors and Small Business Administration offices. To help make this decision, the prospective businessman may start by writing a summary of his background and experience, including that obtained on jobs, in school, and from his hobbies. He should then compare these abilities with the requirements of the kind of business he would like to establish. He should make every effort to choose a business he likes; lack of enthusiasm may lead to failure. But in making this selection, he should remember that the more experience and training he has had which can be put to direct use in operating a particular enterprise, the better his chances of success. The prospective business owner must also choose a type of business that he can adequately finance.

The best way to obtain knowledge of a business is through actual experience in it. If one feels otherwise qualified but lacks sufficient training, he should work for somebody else in the business he is considering, preferably in a well-managed, successful company where he can learn good management methods. Experience in other types of work may teach him something about general business policies and operating methods. The transfer of such experience from one type of business to another is often practicable. The new business owner will need every minute of experience he can get. Exactly how much he will need as a minimum depends upon the business and upon his general business knowledge.

Education will help, too. While there are usually no educational requirements for starting a business, the more schooling one has had, the better equipped he will be for this work. For example, in most businesses, the new owner must know how to figure interest and discounts, keep simple and adequate records, and conduct necessary correspondence. Such knowledge and that of many other helpful subjects may be required through formal education. The new business owner will be more likely to succeed in a business for which he has had some special education.

Next, the person planning to open a business should try to determine as best he can whether customers or clients will like the type of business or service he wishes to establish. The business should be in a field in which expansion is logically expected. A study of surveys, and advice and counsel of experienced businessmen, can help in appraising prospects.

Chances of Success

What are the chances of success for beginning businessmen? Over the long run, the number of firms has been increasing along with the population and industrial growth of the country. In 1900, there were about 1.7 million business firms in the United States, while in 1958, there were about 4.3 million. However, this growth has not been steady. Year-to-year changes in the number of business firms are determined primarily by year-to-year changes in business conditions. As a general rule, poor business conditions are followed by a larger than average number of failures or disappearances, causing the total number of business firms to drop. On the other hand, if business conditions are good, the total number of business firms tends to increase.

Some types of firms had a better survival rate than others. According to a U. S. Department of Commerce study of the 11 years 1944 through 1954[1], wholesale firms had the best survival record. Financial, real estate, construction, and manufacturing businesses did better than average. Service trades were below average, while the retail trades had the lowest survival rate of all.

Half of the concerns which were newly established or acquired by transfer, according to the Commerce study, were sold or liquidated within 2 years. Chances dropped to about 1 out of 3 that a firm would live 4 years and to about 1 out of 5 that it would live 10 years.

But the longer a new firm endured, the greater was its life expectancy. Although at birth a firm could be expected to live 2 years, the study showed that the average firm which passed its second birthday remained in operation an additional 5 years.

Besides general business conditions, other factors, over which the owners have no control, affect individual firms. Examples of these are the relocation of highways, sudden changes in style, the replacement of existing products by new ones, and changes in the local labor supply. While these factors may cause some businesses to fail, they may represent opportunities for others. One local market place may decline in importance, but at the same time new shopping centers may develop. Sudden changes in style or the replacement of existing products may bring troubles to certain businesses but open doors for new ones. Ingenuity in taking advantage of changing consumer desires and technological improvements will always be rewarded.

Starting a New Business

What are some of the practical problems involved in starting a business? How much capital will be needed? Where can it be obtained? What form of business organization will be best? Where should the business be located?

The amount of capital needed to start a business will depend on the kind of business, type of establishment, location, current price level, and many other factors. Small Business Administration field offices help the prospective businessman to determine how much money he will need. He should also become acquainted with a banker; even if his assistance is not needed at the outset, he may be helpful at some later time.

In dealing with the banker, the businessman should openly discuss his plans and difficulties. Bankers do not betray confidence. If financial assistance is needed, the businessman must prepare carefully, in written form, complete information so that anyone approached for aid may gain a thorough understanding of the entire undertaking. Many businessmen or prospective business operators have destroyed their chances of obtaining financial help by the failure to present their plans properly.

Companies which sell equipment or merchandise may also furnish capital in the form of credit. Manufacturers of equipment, such as store fixtures, cash registers, and industrial machinery, frequently have financing plans under which customers may buy on the installment basis and subsequently pay for the equipment out of income. Moreover, the wholesalers or suppliers who deal in merchandise often extend credit. Immediate payment for goods is not required. If the goods are to be resold, no security other than repossession rights of the unsold goods is involved.

One of the principal causes of failure among businesses is inadequate financing. If one goes into business he should remember that it is his responsibility to provide, or obtain from others, sufficient capital to supply a firm foundation for the enterprise.

A person who is planning on going into business may find it necessary to

[1]Age and Life Expectancy of Business Firms, Survey of Current Business, December 1955. Published monthly by the U. S. Department of Commerce.

join with one or more associates in launching the enterprise. He may lack certain technical or management skills which are of major importance to the business he has chosen. Getting a partner with these skills may prove the most satisfactory way of covering the deficiency. Or he may need more capital. Sharing the ownership of the business is one way of obtaining it. Great care, however, should be taken in deciding upon a partner. Personality and character, as well as ability to render technical or financial assistance, affect the success of a partnership.

With associates, a businessman may want to consider establishing either a partnership or a corporation. Even with no associates, he may decide a corporation with minor stockholders is better than an individual proprietorship. Each of these forms of organization has certain advantages and disadvantages, depending upon the circumstances of the particular case.

It is highly desirable that partnership agreements and incorporation papers be prepared by a lawyer. It may be advantageous to consult a lawyer for help in determining the type of organization which best fits the situation.

Where To Locate

Large companies often spend a great deal of time and study on the problem of selecting a new location, attempting to choose it on a scientific basis. The small operator may be unable to afford such a detailed scientific study, but he should evaluate the town to the best of his ability.

If the location of a retail store or service establishment is being considered, assistance in locating may be had from such sources as wholesalers or manufacturers who supply merchandise and equipment; and Federal, State, and local governments.

Population trends should be considered. Is the town growing, or has it already reached the peak of its development? Another important factor is the composition of the population, such as the breakdown by age, occupation, and income. This will have a bearing on the sales volume of a retail business. If a manufacturing business is planned, labor supply is important.

Zoning regulations, the size of the store, the size of the trading area around the city or town, the climate, and seasonality of industries are some other factors that should be considered. Chambers of commerce, State development agencies, and others may have made, or may be familiar with, local community surveys which would provide the information needed.

In what part of the town should the business be located? If the town is very small and one is establishing a retail or service business, there will probably be little choice since only one shopping center will exist.

In the city, outlying shopping centers compete with the central shopping area, and stores spring up along principal thoroughfares and neighborhood streets. There is a recognized trend toward decentralization of business districts.

The kind and variety of merchandise carried will help to determine the type of shopping area which should be chosen. For example, clothing stores, jewelry stores, and department stores are more likely to be successful in the main or outlying central shopping district than elsewhere. On the other hand, grocery stores, drug stores, filling stations, and bakeries do well on principal thoroughfares and neighborhood streets outside the shopping districts.

The zoning ordinances, parking availability, transportation facilities, and natural barriers--such as hills and bridges--are also important in deciding in what part of town to locate the business. Possible sources for this type information are chambers of commerce, trade associations, local real estate companies, local newspapers, banks, city officials, and personal observations.

Management Problems

Inadequate and inefficient management causes more business failures than any other single factor. Few operators of small businesses can afford not to make constant effort to improve management skills.

Skillful buying and pricing are important essentials of profitable operation. Determining what to buy means finding out the type, kind, quality, brand, size, color, and style which will sell the best. This requires close attention to salesmen, trade journals, catalogs, and any signs indicating the likes and dislikes of customers. Analysis of sales records is particularly helpful. Even the manufacturer should view the problem through the eyes of his customers before he decides what materials, parts, and supplies to purchase.

The question of when to buy deserves attention in the many businesses having seasonal variations in sales volume. Sufficient merchandise for sale must be in stock before a seasonal upturn in sales volume. As sales decline, less merchandise is needed. This means that purchases of goods for resale and materials for processing should vary accordingly.

Also, speculative buying is closely related to the question of when to buy. Should a buyer accumulate stock when he believes prices are unusually low in order to take advantage of a possible price rise? Ordinarily, he should avoid speculative buying because it interferes with the normal operations of his business. Although inordinate profits may sometimes be made, substantial losses are equally probable.

How much to buy should be answered by the records of the business. Overbuying will lead to serious financial trouble. On the other hand, one cannot sell merchandise that he does not have. Careful analysis of records plus good judgment will determine the quantities to be bought. Buying on consignment can help reduce investment in inventories.

Chances of success in business will depend considerably on how well the businessman prices his goods or services. If his prices are so low that his margin does not cover expenses, or so high that he cannot build up sales volume, he will fail to make profits.

To establish a business on a firm footing requires a great deal of aggressive, personal selling, except possibly in a mail-order business. The beginning businessman may have established competition to meet. Or, if his idea is new enough to minimize competition, he has the extra problem of convincing people of the value of the new idea. Personal selling work is almost always necessary to accomplish this. If he is not a good salesman, he should seek an employee or associate who is.

Many business failures have been due to failure to keep adequate records. Absence of records may not of itself be the cause of difficulties, but it accounts for the businessman's inability to see in advance the direction in which he is going. With up-to-date records, he may foresee impending disaster in time to take steps to avoid it. While extra work may be required to keep an adequate set of records, this work will more than repay the business owner for his effort and expense. If he is not prepared to accept this chore, he should not try to operate his own business.

An adequate, yet simple, bookkeeping system will enable the small businessman to calculate quickly his volume of sales, expenses, gross and net profits, cash on hand and in the bank, assets, liabilities, net worth, and trends in any of these figures over a period of time.

Other types of records are sales and merchandise control records. These records break down sales and inventory figures into classifications that enable the owner to answer such questions as: What products, or services, do my customers like best, next best, and so on? Do I have the right merchandise in stock to give them what they like? Or, am I prepared to render the service they demand most? He needs to know what has happened in the past to help him plan for the future.

Furthermore, the business owner needs records to substantiate his returns under Federal and State tax laws, including income tax and social security laws; his request for credit from equipment manufacturers or a loan from a bank; or his claims about the business, should he wish to sell it.

Where To Get More Help

This article has presented some of the general problems one should consider in planning to start and manage a small business. For help in working out specific plans, prospective business owners should contact the nearest field office of the Small Business Administration. These offices, located in 53 of the larger cities throughout the Nation, are listed in the local telephone directories.

Copies of the report on which this article is based--Starting and Managing a Small Business of Your Own (a Small Business Administration publication)--can be obtained from the Superintendent of Documents, Washington 25, D. C., price, 40 cents per copy.

MATHEMATICS AND YOUR CAREER

Counselors and mathematics teachers in many parts of the country are using this 12-page, illustrated pamphlet, which lists 82 occupations requiring a knowledge of mathematics and indicates the amount of mathematics training needed for each type of work. It has proved to be very useful in pointing out to students the importance of such training.

The demand for the pamphlet has been so great that the supply has been temporarily exhausted, but a second printing is now on order. Persons who have already requested copies will receive them immediately after the new supply is available. In addition, the U. S. Department of Labor's Bureau of Labor Statistics has issued a poster, Math Helps in Your Career, presenting some of the highlights of the information in the pamphlet to help meet counselors' and teachers' immediate needs.

Requests for copies of this poster or for copies from the second printing of the pamphlet should be addressed to the Occupational Outlook Service, Bureau of Labor Statistics, U. S. Department of Labor, Washington 25, D. C.

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OCCUPATIONS IN SPACE EXPLORATION

by Mannie Kupinsky

Until recently, the general public read or heard about space travel only in comic books and science fiction publications. But with the arrival of the space age, children who today are playing with toy space helmets and ray guns may in their lifetimes travel between planets in spaceships. Current happenings in space technology have created a tremendous interest among young people in this field of work.

Employment in the space exploration field includes all workers who spend the major share of their worktime directly engaged in research, development, and manufacture of space vehicles and/or directly related data collection programs. Workers who manufacture such rockets as the Jupiter and Thor, which are used in the space program, are excluded because the major application of these rockets is as military ballistics missiles. Those who work or collect data on general astronomical studies by means other than a space vehicle are also excluded.

The direct work force in the space field numbered about 30,000 in mid-1958; and employment is expected to expand rapidly in the next few years. Also, many additional thousands of workers contribute to this program by constructing facilities or manufacturing equipment for use in space exploration.

What kinds of workers are needed in this new and exciting field? The Nation's space exploration program is carried on by a work force that includes exceptionally high scientific, technical, and craft skills. Few, if any, large fields of employment have as high a proportion of technical personnel as does the space field.

What Is the Space Exploration Program?

Space exploration became an increasingly important activity in this country following the end of World War II. A number of scientific teams were formed to explore the upper atmosphere and the space beyond. These teams used rockets, such as the Aerobee and Viking, to aid their research. Later, a balloon-rocket technique was also developed. The International Geophysical Year program in 1958 has added impetus to the Nation's space exploration program.

The civilian space program is now directed primarily by the National Aeronautics and Space Administration. The NASA contracts out a large portion of the work involved in space experiments but also does a great deal of the work in its own facilities. There is also a military space program directed by the Advanced Research Projects Agency of the Department of Defense. Scientists in these two agencies design experiments which have as their goal the extensive collection of data on space environment. Eventually, it is hoped that these data will provide information needed for the construction of manned space craft for interplanetary travel.

Space experiments involve the design of instruments to collect space data and of satellites to carry the instruments; the use of rockets to launch the satellites into space; and the use of guidance systems to direct satellites into orbit around the earth, moon, or one of the other celestial bodies. Currently, most of the rockets (as well as the ground handling and launching equipment) used in the program are those developed for the military missile program.

Jobs in the Space Field

Many kinds of engineers and scientists contribute to the work of NASA and the Advanced Research Projects Agency. Important among the specialists employed by these agencies are aerodynamicists, powerplant engineers, and aeronautical instrumentation engineers. Many types

Scientists inspect lightweight satellites which inflate automatically after being ejected into space

of technicians, such as mathematical aids and electronic specialists, are employed to assist the engineers and scientists. A large number of highly skilled craftsmen (including model makers, instrument makers, aeronautical laboratory mechanics, electricians, machinists, and sheet metal workers) also work closely with the engineers and scientists.

The NASA and ARPA contract out, in part, the work of designing and producing the instruments and satellites to industrial or university research laboratories. These laboratories employ scientists and engineers with almost every scientific specialty, the most important being in the fields of electronics, aerodynamics, chemicals, and metallurgy. Aiding these scientists and engineers are technicians with chemical, mechanical, electromechanical, and electronic training and experience. Assembly and testing of satellites and their components is done by technicians under the supervision of engineers, while the production of instruments is carried on by highly skilled experimental machinists.

Rockets for launching space craft are produced by rocket engine manufacturing plants. A typical plant employs aeronautical, mechanical, electronic, and chemical engineers. Mathematicians, chemists, and physicists are three of the more important scientific workers employed in these plants. Technicians assisting these engineers and scientists include engineering aids, electronic technicians, draftsmen, computer programmers, and physical science aids. Laboratories and plants working on rocket development and production also employ such highly skilled crafts-

men as laboratory mechanics, instrument makers, model makers, tool and die makers, and electroplaters.

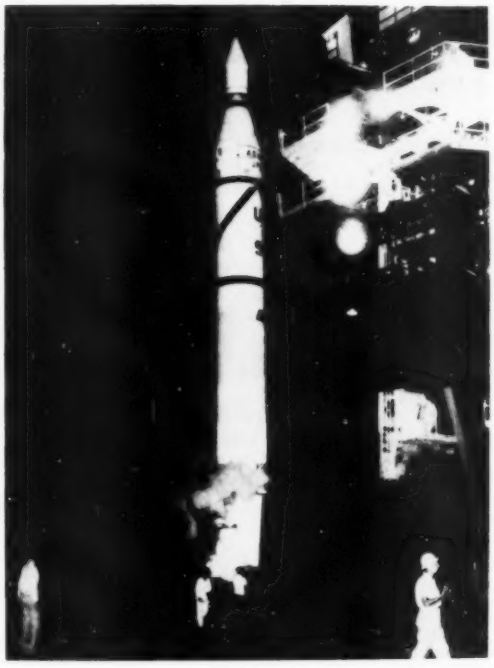
Plants manufacturing electronic devices produce the guidance systems used to direct the rocket-satellite package. Electronic, mechanical, and aeronautical engineers are employed by these plants to help design and manufacture these systems. They are assisted by junior engineers, draftsmen, and laboratory and electronic technicians. Among the production workers, there are model makers, machinists, electronic technicians, tool and die makers, and highly skilled assemblers and inspectors.

The completed satellite and rocket with instruments and guidance systems are transported to the launching site where the engineering and scientific staff includes virtually every physical science specialty. There is also a large group of technicians and craftsmen who are engaged in checking and preparing the rocket and satellite for launching. These include electronic technicians, calibration technicians, missile instrumentation technicians, missile test mechanics, and missile inspectors.

After the launching, electronic instruments in the satellite radio back to earth whatever data the satellite has been instrumented to collect. Tracking stations that have been alerted to the launching receive these data through their electronic equipment. The teams at the tracking stations, which may include as many as 20 people at each installation, are made up of electronic engineers and physicists, who are assisted by electronic technicians, equipment technicians (equipment operators), and communications operators. If the tracking stations are located in foreign countries, the staffs may include translators.

Tracking stations send the data they receive from the satellite to data-processing centers. Mathematical programmers at these centers have prepared electronic computers to receive and process the masses of data they receive from the tracking stations.

Scientists of the National Aeronautics and Space Administration, the Advanced Research Projects Agency, and the university and industrial laboratories that are involved in the experiment analyze the data collected by the satellite. The knowledge gained permits additional and broader experiments which provide still more data for the space scientists. This ever-increasing bank of knowledge of the space environment brings nearer the day when Man, expert in space technology, will start the conquest of his most challenging frontier--the frontier of infinite space.



The Department of Army's Jupiter C missile stands ready for firing

INCREASE IN SCIENTIFIC, ENGINEERING, AND OTHER TECHNICAL JOBS

Results of a New Survey Show Phenomenal Growth

by Harold Goldstein

A remarkable expansion in jobs for scientists, engineers, and technicians in industry is revealed by a new survey just released by the National Science Foundation. The survey, on which this article is based, was made for the Foundation by the Bureau of Labor Statistics. It shows where these technical jobs are located, and how fast they have been increasing in each industry.

Two Million Technical Workers in the United States

Nearly 2 million people were working as scientists, engineers, or technicians in the United States in 1957. Employment in these occupations has grown very rapidly in response to the demands of World War II, the Korean conflict, and a vastly expanded research and development effort in American industry. In 1940, there was only 1 scientific or technical worker for every 100 workers; by 1957, 1 out of every 32 workers was found in these occupations. In this period, such products as TV, jet airplanes, missiles, space vehicles, electronic computers, atomic reactors, and antibiotics have been developed. With 2 million trained people engaged in discovering scientific principles and applying them to practical use, the pace of invention and technical change can be expected to continue even more rapidly than it has in the past 18 years.

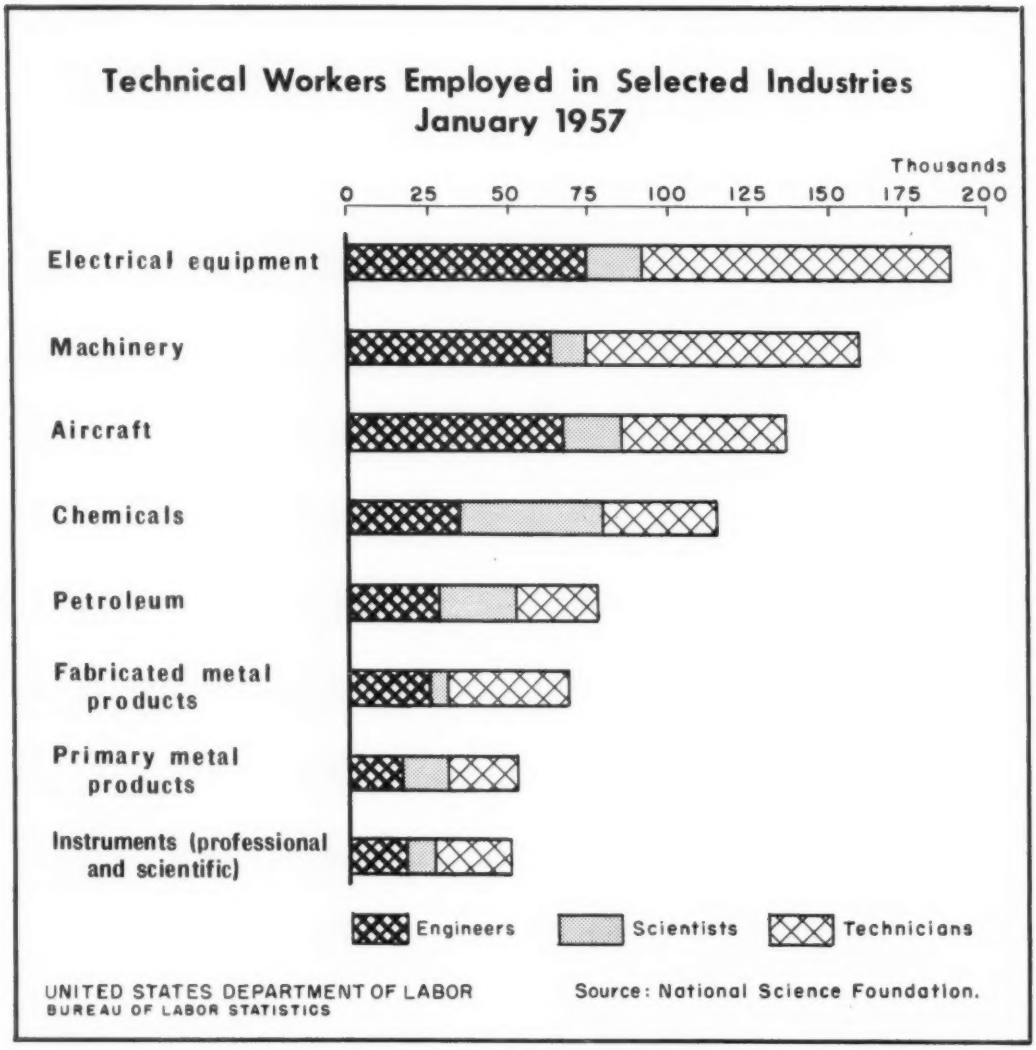
More than half of the nearly 2 million technical workers studied were professional scientists and engineers. The remainder were technicians--workers with some education beyond high school, or equivalent experience, who work with and assist the engineer or scientist. Typical technicians are draftsmen, electronic repairmen, engineering aids, and laboratory technicians.

Most technical workers were found to be employed in private industry--528,000 engineers, 210,000 scientists, and 595,000 technicians worked in industry in 1957. The others were employed in government agencies, colleges and universities, and nonprofit research foundations.

Major Industries Employing Technical Workers

Among the industries studied, the largest technical staff was employed by the manufacturers of electrical equipment, including radio, TV, and other electronics equipment, and electrical machinery. The 75,000 engineers, 95,000 technicians, and 18,000 scientists who worked in this industry in 1957 are in large part responsible for such electronic marvels as television, radar, and the complex gadgets that guide missiles and space vehicles. More than one-third of these people were working on research and development projects. The scientific and engineering staff of this industry is one of the fastest growing of all industries, having expanded by 50 percent in the 3 years ending in January 1957.

The machinery industries had a technical staff of 158,000, including 63,000 engineers, 12,000 scientists, and 83,000 technicians. These firms are constantly developing new machinery, including nuclear reactors and automated industrial machinery. Nearly a third of these workers were doing research and development work. Growth in scientific and engineering jobs in these industries was slower than the average for these jobs in all industries studied; the increase since 1954 was only 17 percent.



Third largest user of these technical workers in 1957 was the aircraft industry, which has been active in developing jet planes and missiles. The 66,000 engineers and 19,000 scientists working in aircraft plants were assisted by 51,000 technicians--a total of 136,000 technical workers. In the 3 years after 1954, the industry's technical staff grew by 75 percent--more than twice as fast as the all-industry average for these jobs, and faster than any other industry. That 65 percent of the industry's technical staff was engaged in research and development work--a higher proportion than in any other industry--emphasizes the rapid development in the missile field.

Rapid Growth of Scientific and Engineering Jobs in Industry

Professional scientific and engineering jobs in industry have been growing at

a rate of about 9 percent a year, or a total increase of 28 percent for the 3 years ending January 1957.

Engineering jobs increased at about the same rate. The 528,000 engineers were widely distributed among the industries. One out of three engineers was engaged in research and development; but in the aircraft industry, where technical advance has been so rapid in the last few years, 2 out of 3 engineers were working at research and development.

The fastest growth was in an occupation old in history but new in industry--mathematicians. Since the days of Euclid and Pythagoras, and until recent years, the mathematicians worked primarily as teachers in schools and colleges. But in the last few years, mathematicians, aided by electronic computers, have been called on to solve difficult problems facing research scientists in industry. For the first time in history, more mathematicians are working in industry than in colleges and universities. In January 1957, 12,000 mathematicians were in industry --their number nearly doubling in the 3 years since 1954.

Also showing rapid employment growth were the life sciences (biology, etc.)--which expanded by 60 percent in 3 years. This was a period of rapid advances in antibiotics, the development of the Salk polio vaccine, and substantial Federal aid for research on cancer, heart disease, etc. In 1957, nearly 17,000 life scientists were in industry--mainly in the manufacture of chemicals (including drugs) and in the various food industries.

Among the fastest growing scientific fields in industry was physics. The 12,000 physicists employed in January 1957 were 60 percent more than the number employed 3 years earlier. Physicists were employed in many different industries, but more than a third of them were in the electrical equipment industry and a sixth were in the aircraft industry.

Chemists find jobs in a great many different industries, but 40 percent of them were in the chemicals industries. Even though the overall growth rate was moderate, employment of chemists has shown rapid percentage gains in industries with relatively small chemical staffs--especially aircraft, machinery, and rubber products.

About 72,000 chemists worked in industry in 1957. This large field has also been growing, but at a slower rate than the other occupations mentioned--only 16 percent in 3 years.

Something New in Occupational Information

Statistics on the total number of workers in each industry have been collected every month for many years. They are used to keep an eye on the current "health" of each industry and community, as well as to study long-term trends in employment. These statistics are collected by the Department of Labor in cooperation with State agencies, and are published each month in the Monthly Labor Review and Employment and Earnings, issued by the Bureau of Labor Statistics.

Periodic information on nationwide employment in the various occupations within each industry has been long needed, but up to now has been collected only once every 10 years, in the decennial census. Beginning in 1954, the National Science Foundation launched a new program to collect data on technical employment in each industry. The survey was repeated for 1957, and, beginning in 1959, surveys will be made annually. The trends from 1954 to 1957, described above, give clear insight into the rapid growth of technical jobs since 1950.

If similar data can be collected regularly on other types of occupations as well--skilled, clerical, professional, sales, etc.--the guidance profession will for the first time have the basic up-to-date information it needs on employment trends in occupations, and on where the jobs are.

EMPLOYMENT OUTLOOK FOR INSTRUMENT MAKERS*

by Joseph A. Brackett

Expanding programs of research, development, and testing, and the growing dependence upon instruments in industrial production are making the instrument maker's job increasingly important. Modern science and industry are finding significant uses for new and complex instruments which can "see" where the human eye cannot; measure forces which the most delicate human touch cannot perceive; operate under conditions too hazardous for humans; and record and interpret complicated, fast-changing situations in a millionth of a second--much faster than the most agile brain. Instruments enable man to inspect the interiors of metals for signs of weakness, to observe and influence the internal functioning of blast furnaces and atomic reactors, and to control guided missiles. Instruments originate as ideas of scientists and engineers. The highly skilled instrument maker translates these ideas into practical working models which can be tested and developed. Many of these pilot models may eventually be produced in large quantities.

Nature of Work

Instrument makers (often called experimental or laboratory machinists or model makers) work closely with engineers and scientists in translating designs and ideas into experimental models, special laboratory equipment, and other nonstandard instruments. Their work also includes changing existing instruments to serve special purposes. Some of the devices constructed by these craftsmen for experimental purposes are used to measure heat (thermostats) and distance (geodimeters), record earthquakes (seismographs), and help control industrial processes (servomechanisms). The instrument parts and models made by these workers range in complexity from simple gears to the intricate navigation systems used in guided missiles.

In performing their work, instrument makers frequently use skills which are similar in many respects to those of all-round machinists, tool and die makers, and layout men. Like these other machining workers, instrument makers fabricate metal parts by operating machine tools, such as lathes and milling machines, and by using hand-tools, such as files and chisels. They also determine the sequence of machining operations and follow blueprint instructions. Because the parts fabricated by all these workers must be machined precisely, finished parts must be accurately measured with micrometers and standard optical measuring instruments. Finally, the instrument maker and the other machining workers make devices needed to hold metal parts in place and guide the tools which shape them.

However, there are certain significant differences between the instrument maker and these other machining workers. Generally, the instrument maker works more from rough sketches, verbal instructions, or only ideas given to him by a scientist or engineer. In order to solve the practical fabrication or design problems that arise from such directions, he frequently must use considerable imagination and ingenuity. Furthermore, the instrument maker usually does more exacting work, than other skilled machining workers because the parts on which he works sometimes may not vary more than one ten-thousandths of an inch (which is 30 times smaller than a human hair) or even a few millionths of an inch. In order to

*This article is one of a series presenting new and revised information on fields of work covered in the 1957 edition of the Occupational Outlook Handbook. It is based on the Bureau's continuing program of occupational outlook research.

meet such standards, instrument makers commonly use special equipment or precision devices, such as the electronic height gage and the cavitron (a machine tool which shapes hard materials by means of vibrations), which are used only infrequently by other machining workers. Another important difference is that the instrument maker works with a greater variety of materials than do other machining workers; he has to know the working properties of plastics, wood, glass, and rubber, as well as the rarer metals such as silver, platinum, and tungsten.

Instrument makers must be able to construct instruments from start to finish--making the metal parts, assembling them into complete instruments, and testing the finished instrument to see that it performs the operation for which it was intended. However, in large companies or where time is important, an instrument maker often will not assemble an entire instrument. In such instances, he will cooperate with other instrument makers, each making a complete part or component of some larger and more complicated instrument.

Because they work with minimum supervision and possess highly developed manual skills and reasoning abilities, instrument makers have considerable prestige and are often referred to as "master mechanics."

Where Employed

Most instrument makers are employed by firms which manufacture industrial instruments; laboratory equipment; nautical, aeronautical instruments for both civilian and military users; optical products; and recorder-controllers. The Federal Government employed about 1,200 instrument makers in 1958, most of whom worked in the following agencies: Army, Navy, Air Force, National Institutes of Health, Coast and Geodetic Survey, National Bureau of Standards, and the National Aeronautics and Space Administration. University and commercial research laboratories also employ instrument makers to make the special devices required in scientific research.

The main centers of instrument making are located in and around a few large cities, particularly Rochester, N. Y., New York City, Chicago, Minneapolis-St. Paul, Los Angeles, Boston, Philadelphia, and Washington, D. C.

Training, Other Qualifications, and Advancement

Most instrument makers advance from the ranks of machinists or skilled machine-tool operators. These craftsmen, working at first under close supervision and doing the simpler jobs in the instrument shop, usually need at least 1 or 2 additional years of experience to qualify as instrument makers.

Other instrument makers learn their trade through instrument-maker apprenticeships which generally last 4 or 5 years. The apprentice's shop training emphasizes the use of machine tools, handtools, and measuring instruments, and the working properties of various materials. Classroom instruction covers related technical subjects, such as mathematics, physics, and blueprint reading. The apprentice must learn enough shop mathematics to be able to plan his work and use handbook formulas. A basic

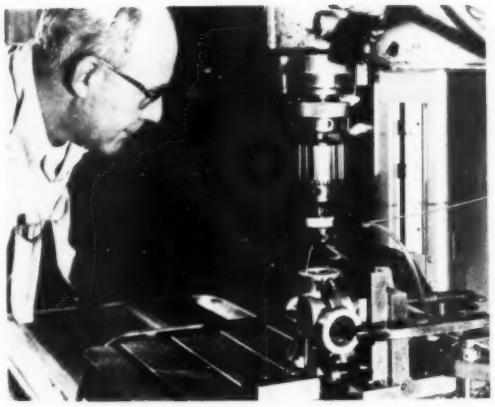
Instrument maker measuring internal diameter of a ring with an electronic device accurate to a millionth of an inch

knowledge of mechanical principles is needed in solving gear and linkage problems.

Employers generally prefer applicants who have a high school education, including courses in algebra, geometry, trigonometry, science, and machine-shop work. Further technical schooling in electricity and electronics is often very desirable and may make possible future promotions to higher level technician positions.

A young man interested in becoming an instrument maker should have a strong interest in mechanical subjects and a better than average ability to work with his hands. More importantly, he must have great initiative, resourcefulness, and ingenuity, because instrument makers often work alone and almost always under minimum supervision. Since the instrument maker also commonly faces problems which may not have been solved previously, he must be able to develop original solutions. The instrument maker frequently must visualize the relationship between individual parts and the complete instrument. He must also understand how the instrument is used and the principles of its operation. Because of the nature of his work, the instrument maker has to be very conscientious and take considerable pride in creative activity. For all these reasons, this is an occupation which requires flexibility in working with new ideas, new tools, and new materials, and the willingness to work on nonroutine assignments.

As the instrument maker's skill improves and as he broadens his knowledge, he may advance to increasingly responsible positions. About 10 years' experience is required to rise to the top skill level in instrument making. With additional training beyond the high school level in subjects such as physics and machine design, some instrument makers may advance to higher level technician jobs. In these jobs, technicians plan and estimate time and material requirements for the manufacture of instruments, or provide specialized support to professional personnel. Others may become supervisors of less skilled instrument makers and help in their training.



Instrument maker using an air gage to position a hole precisely prior to boring

Employment Outlook

The employment of instrument makers is expected to continue to increase rapidly during the 1960's. However, the number of new openings in any one year will be limited by the relatively small size of the occupation. Probably not more than 30,000 workers were employed as instrument makers in 1958.

The devices made by instrument makers are playing a key role in the remarkable expansion of science and technology which is revolutionizing our industry and defense. Instruments are of basic importance in atomic energy, guided missiles, and automation (the use of instruments to direct and control manufacturing and other processes). In addition, new electronic communication equipment and computers also depend upon the development of instruments.

Research and development expenditures, which reached an estimated $10 billion in 1958 and are expected to continue to increase in the next decade, will have a favorable effect upon instrument maker employment. New precision instruments which are even more versatile and sensitive than those in current use are expected to emerge

from the future research and development programs of universities, government agencies, private laboratories, and manufacturing firms.

Many critical technical problems can be solved only by the development of new instruments. For example, scientists who work with atomic reactors need better control systems for indirect handling of radioactive materials and improved "thermometers" which can measure temperatures in the millions of degrees. A need for new kinds of instruments is generated by giant research projects such as the recent International Geophysical Year, a project designed to increase and pool geophysicists' and astronomers' knowledge of the earth and outer space. Similar greater use of instruments is also occuring in factory production because of the increasing installation of production systems that are engineered for instrument control. New achievements, such as the exploration of polar regions by nuclear-powered submarines and the launching of satellites and guided missiles, all depend on instruments for navigation and communication. Instruments can also be used to save the time and labor of scientists and engineers in research and development, who are in short supply. All of this means that there will be increasing employment opportunities for instrument makers.

Spending for research and development and for replacement of obsolete equipment will contribute importantly to the anticipated very large increase in instrument sales, but employment of instrument makers probably will rise more slowly than sales. In many cases, instruments can be standardized and produced in large quantities, without hiring additional instrument makers. In these instances, the work can be broken down into several simple steps and performed by semiskilled assemblers.

However, the possibilities of specialization in both the skills and processes of instrument manufacturing are limited. There are indications that unique, custom-made, and special-purpose instruments, all typical products of the instrument maker, are of increasing importance, especially in fast changing fields such as the electronic, petroleum, and chemical industries. Specialization is also limited because laboratories and model shops do not produce large quanities of any one instrument. Another limit to specialization in instrument making is that laboratory and model shop instrument workers must be all-round craftsmen even to perform apparently specialized tasks such as precision grinding and drilling.

In addition to new job opportunities for instrument makers that will occur as a result of expanded industrial, scientific, and defense requirements, there will be several hundred new openings annually for these craftsmen as a result of retirements and deaths, promotions, and transfers to other fields of work.

Earnings and Working Conditions

Earnings of instrument makers compare favorably with other highly skilled metalworkers. Wage data obtained from a small number of instrument manufacturers and research laboratories and from selected union contracts indicated that wages of these craftsmen in 1958 generally ranged from $2.50 to $3.25 an hour. A few skilled instrument makers employed by the Federal Government in Washington, D. C., were receiving hourly pay of $3.50; others received annual salaries ranging from $4,490 to $7,335.

Instrument shops usually are clean and well lighted, and often air-conditioned, in order to facilitate precision work. Machines used in these shops make little noise because generally they are small and do not run continuously.

Serious work accidents are not common among instrument makers; but they are exposed to finger, hand, and eye injuries from flying particles and moving tools. Safety rules generally require the wearing of special glasses, aprons, tightly fitting clothes, and shirts with elbow-length sleeves; the wearing of neckties is prohibited.

Many instrument makers belong to unions, two of which are the International Union of Electrical, Radio and Machine Workers and the International Association of Machinists.

NEW STUDY ON

IMPACT OF AUTOMATION ON OFFICE EMPLOYMENT

Automation and Employment Opportunities for Officeworkers, a new BLS bulletin, deals with the implications of electronic computers for officeworker personnel. It also describes the programmer, one of the new occupations created by electronic computers in terms of nature of work, training required, place of employment, job outlook, and earnings.

Although new occupations are being created by the use of electronic data-processing systems, other jobs are being abolished or the functions of workers are being changed. The study indicates that, in general, clerks employed in routine and repetitive jobs are the workers most likely to be adversely affected by the installation of electronic equipment. Clerical workers in jobs requiring the use of considerable judgment or contact with other people are least affected by automation.

Clerical workers, the report reveals, numbered more than 9 million in mid-1958 and accounted for 1 of every 7 workers in the United States. This proportion was greater than in any previous year. In 1910, only 1 in 20 workers was in a clerical occupation. The rapid rise in clerical employment reflects the ever-increasing volume and complexity of the clerical work handled by the Nation's expanding industries and by Government. Although the years have witnessed the introduction of office machines such as typewriters, calculators, bookkeeping, billing, and duplicating machines, clerical employment has continued to rise. In the last few years, however, there has been concern whether electronic computers, which perform millions of computations with lightning speed, will reduce the number of clerical jobs.

BLS Bulletin 1241 is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 15 cents.

EMPLOYMENT OUTLOOK FOR OVER-THE-ROAD TRUCKDRIVERS*

by Arthur Schatzow

The men at the wheels of the big trucks seen on our highways and turnpikes have the top driving jobs in the country. These men drive the largest and most expensive equipment and receive the highest wages of all drivers. They are on their own practically all the time and have a great deal of responsibility. They must often exercise considerable initiative to deliver loads within set time schedules.

Nature of Work

Most over-the-road drivers operate gasoline- or diesel-powered tractor-trailers. (The tractor is the truck with the very short chassis which draws the trailer in which the freight is carried.) They deliver goods usually over long distances--frequently driving at night.

Unlike the local truckdriver who spends considerable time in loading and unloading, the over-the-road driver (sometimes called intercity driver, line-haul driver, or long-haul driver) spends practically all of his working time in driving. He may, however, sometimes handle the freight he transports. Some drivers, for example, may have to unload their goods because they make deliveries to stores at night when there are no receiving crews on hand. Drivers of long-distance moving vans generally have to load or unload their vehicles, with the assistance of helpers obtained locally.

The truckdriver must back up his big trailer to loading platforms. This requires the ability to maneuver the trailer precisely while driving in reverse. The driver must also be able to judge distances accurately while driving around corners or through narrow passageways.

Because the over-the-road truckdriver spends most of his time driving, safe driving practices and courtesy are of the utmost importance. Everyone has seen the emergency warning signals set out by a driver near his disabled truck on the edge of the highway. Many motorists have noted the courtesy of truckdrivers who pulled off to the shoulder of the road at the top of a hill to allow the accumulated traffic to pass.

Interstate Commerce Commission regulations require drivers to inspect their trucks before and after trips and make out reports on the condition of the vehicles at the end of the run. Drivers are also required to keep a daily log of their activities. If a driver has an accident, he must make out a detailed report.

Where Employed

The more than one-half million over-the-road driving jobs are scattered throughout the United States. Many drivers work out of some of the large cities, such as Chicago and Los Angeles; however, some large companies have their operating headquarters in fairly small towns.

About half of the drivers work for private carriers such as chain food stores or manufacturing plants which use trucks to transport their own goods. The remainder are employed by for-hire carriers which are either common carriers (trucking companies serving the general public) or contract carriers (trucking firms hauling goods under contract only for certain companies).

*This article is one of a series of reports on fields of work which could not be covered in the 1957 edition of the Occupational Outlook Handbook. It is part of the Bureau's continuing program of occupational outlook research.

Most of the drivers of the big tractor-trailer combinations on long intercity runs are employed by common carriers. On shorter hauls, many drivers are employed by contract or common carriers to make deliveries of machinery, food, petroleum products, household appliances, and other items, from plants to warehouses and from warehouses to some large-volume purchasers.

Qualifications, Training, and Advancement

Regulations of the Interstate Commerce Commission establish minimum qualifications which over-the-road drivers must meet. The driver must be at least 21 years of age, able bodied, with good hearing and vision of at least 20/40 with or without glasses. He must be able to read and speak English, have at least 1 year's driving experience (which may include driving private automobiles), and a good driving record. Most States require truckdrivers to have a chauffeur's license, which is a commercial driving permit obtained from the State Motor Vehicle Department.

These are minimum standards which apply to all over-the-road drivers. Most fleet operators, however, have higher standards. Many firms will not hire drivers below the age of 25. Some employers have height and weight limitations. Many require applicants to have at least a grade school education; others require 2 years of high school. Some companies will employ only an applicant who has had several years of experience in handling vehicles of the type he would be required to drive.

The truck-trailer combination seen on our highways often costs as much as $20,000 and the load inside may be worth much more. The owners of this equipment, therefore, employ drivers with a know-how based on years of driving experience who can accept great responsibility.

Many training authorities and employers recommend that young men interested in becoming professional drivers take the driver-training courses offered by many of the Nation's high schools. If such a high school course is not available, the professional driving schools which operate in most large cities are recommended. A high school course in automotive mechanics is also very helpful.

Most over-the-road drivers have had experience in local trucking. Usually they have entered this occupation by first driving a small, light truck. After gaining experience they have moved on to the larger and more complicated trucks. A young man may also begin as a helper who assists a local truckdriver in loading and unloading the truck and may occasionally do some driving to relieve the driver.

Another type of experience considered very desirable by employers is a combination of intercity bus and local truck driving. This experience may be gained by working for an intercity bus company in the spring and summer months and by working for a local trucking company during the fall and winter months delivering such products as fuel oil. Thus, the driver gets the road experience with the bus company and learns how to handle a truck and trailer with the local trucking company.

Driver records information on forms before starting on trip

All employers are interested in obtaining good, safe, reliable drivers, but methods of selection and training vary. Some companies have formal tests and training programs. Other companies do their hiring on the basis of personal interviews and their training program consists of a "break in" period during which the new employee observes and works with an experienced driver.

Applicants for jobs as over-the-road drivers are required to pass a physical examination which is usually paid for by the employer. Many firms also give written traffic and driving knowledge tests. Some employers give tests to measure such factors as reaction time, vision acuity and field of vision, ability to judge speed, and emotional stability.

The last step in the selection of drivers is the road test. The applicant is expected to demonstrate his ability to handle, under a variety of driving conditions, a vehicle of the type and size he will operate in regular service.

A new driver may be given a brief indoctrination course. Company policy is explained and the new employee is taught how to prepare the various forms he will use on the job. The new driver will then make one or more training trips with an instructor or an experienced driver.

Drivers employed by common carriers frequently start on the "extra board," getting regular runs on the basis of seniority as vacancies occur. (The "extra board" is a list of men, assigned in rotation, who substitute for regular drivers or who make extra trips when necessary.) Drivers for private carriers are more likely to begin with assigned regular routes.

Promotional opportunities in this occupation are limited. A few drivers may advance to jobs as safety supervisors, driver supervisors, and dispatchers. Most drivers, however, can look forward only to runs which will give them higher earnings.

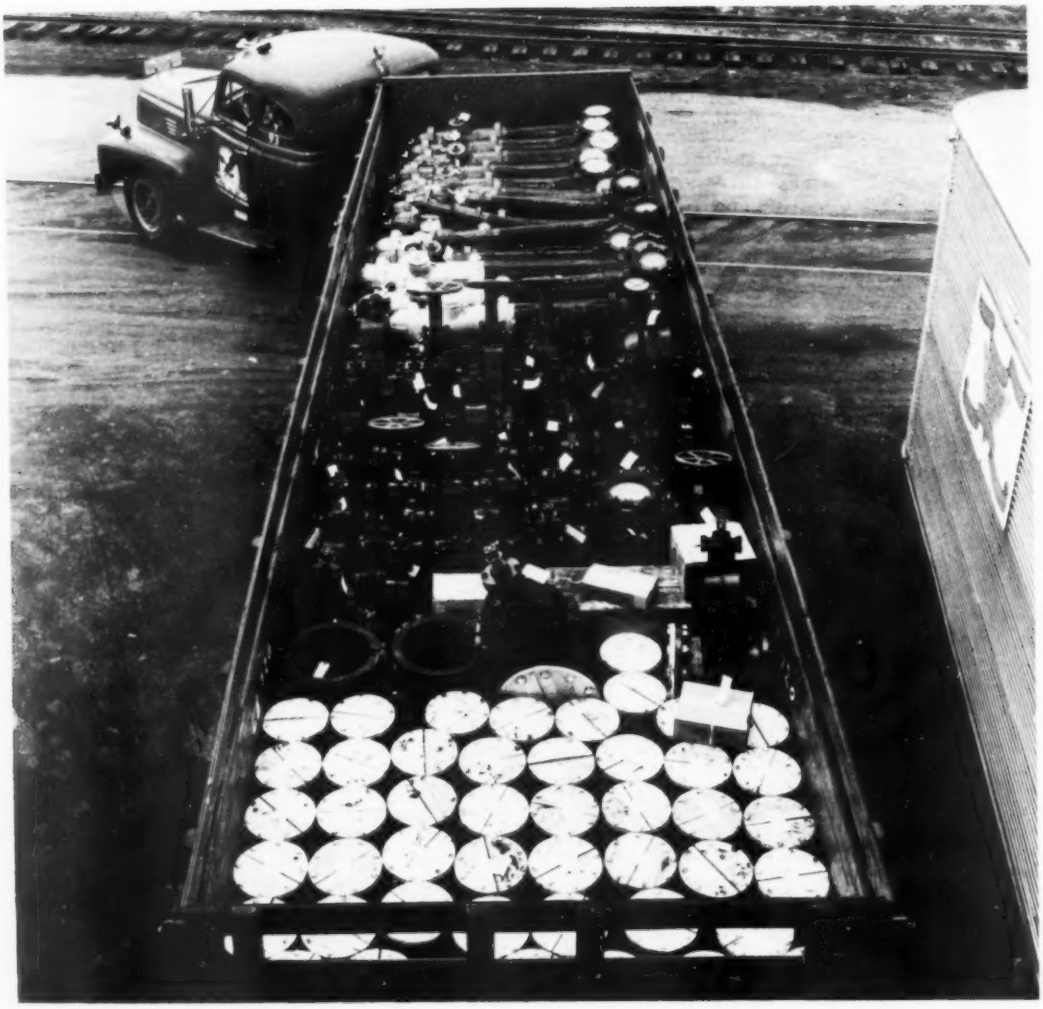
Employment Outlook

A very substantial increase in the employment of over-the-road truckdrivers is anticipated during the 1960's as a result of increased industrial activity, a continuation of the decentralization of industry, and the movement of population to the suburbs. A large number of job openings will also be created by transfers from truck driving into other fields of work. For example, many long-haul truckdrivers often return to local truck driving jobs. Several thousand additional openings will also result each year from retirements and deaths.

Most of the increase in over-the-road driving jobs will result from an increase in the volume of freight hauled by trucks. This represents a continuation of a trend which has been evident in the recent past. The freight carried by over-the-road trucks has been rising as a result of the general economic growth of the Nation and because trucks have been hauling an increasing proportion of the total freight. Furthermore, many factories, warehouses, and stores are being located at great distances from each other in suburban or semirural areas where rail facilities are nonexistent or extremely limited. The growth of chain stores and the trend in the building of plants, whose products are part of a highly integrated manufacturing operation, both require daily coordination of shipping and this will also contribute to the increase in the amount of freight handled by trucks.

Improvements in trailer design, such as better refrigerated trailers, have also contributed to the expansion of over-the-road trucking. These advancements have made it possible to ship certain kinds of freight for longer distances by truck than was previously possible.

Some recent freight transportation innovations may limit somewhat the anticipated increase in trucking business and driver employment. For example, "piggyback," the movement of highway trailers on railroad flat cars, which saves the cost of driver, fuel, and



Backing a large trailer up to a loading platform requires considerable skill

tractor, appeared to have promising prospects, but as yet has had little effect on the trucking business. The increasing use of trailer-carrying ships, recently introduced, for the transportation of loaded trailers for long distances, could also adversely affect the employment of over-the-road truckdrivers. In any event, the effect of these innovations would be largely limited to the movement of those commodities where the time element is not too important.

It is also possible that the trucking business may undergo a considerable expansion without a corresponding increase in driver employment. State limitations on truck weight, size, and speed are being liberalized as a result of the construction of better highways. The movement of bigger loads at higher average speeds could result in a need for fewer drivers than would otherwise be required to move the tremendous increase of over-the-road tonnage anticipated during the 1960's.

The over-the-road driver has a better chance of remaining employed during business recessions than workers in many other occupations, because manufacturers and merchants, unable to buy in large car lot quantities, can reduce inventories and still maintain diversified stock with small daily shipments by truck.

Earnings and Working Conditions

Most over-the-road drivers earned well above $100 a week in 1958. Drivers employed by class I common carriers (carriers with gross operating revenues of $1 million or more a year) of general freight had average annual earnings of $6,886 in 1957, the most recent year for which such data are available. The rates paid to over-the-road drivers are fairly uniform because this is a highly unionized field and union contracts are generally master agreements covering all employers within a region--an area including a number of States. Furthermore, because drivers working under different contracts often travel the same routes, even the various regional contracts tend to be uniform. The earnings of an individual driver are affected by such factors as the mileage driven, the number of hours worked, the type of equipment driven or the weight of the loads carried, and the type of "run"--whether or not pickup or delivery is required.

Drivers on the longer runs are generally paid on a mileage basis for the time spent in actual driving. For all other time on duty, the driver is paid at an hourly rate. This includes waiting time, delay time due to breakdown of equipment or impassable highways, layover time (time spent at a terminal away from home beginning at some designated hour after his run ends), and time spent in making pickups or deliveries enroute. Regular drivers are usually assured minimum pay for a certain number of hours--generally 8 hours a day and 40 to 48 hours a week.

Some private carriers pay their drivers on the same basis as their other employees--a monthly, weekly, or daily wage. Generally, such a wage is for a specified number of hours; if the driver works beyond that, he receives extra pay.

Interstate Commerce Commission regulations limit the hours of work of over-the-road drivers. No driver may be on duty for more than 70 hours in any 8-day period. After driving for 10 hours, a driver must be off duty for at least 8 hours before he may drive again. Many drivers, particularly on very long runs, work almost the maximum number of hours permitted. A workweek of at least 50 hours is very common.

Most drivers receive 6 paid national holidays plus 1 or more State and local holidays. They also receive paid vacations, usually from 1 to 4 weeks depending upon their length of service. Health, insurance, and pension plans, usually paid for by the employers, are very common.

Over-the-road truckdrivers are often required to spend time away from home --particularly when they drive long runs. The driver often starts out in the evening and arrives at the terminal in the other city the following morning. There, the company provides lodging for him either in a company dormitory or a hotel. In the evening, he starts on his return trip and arrives at the home terminal the following morning. The driver may make 2 or 3 such round trips a week. If the trips are part of a relay operation, another driver is working a similar schedule starting from the other end of the run.

Some companies use 2-man sleeper teams on their very long runs. One drives while the other sleeps in the little bunk behind the cab. The vehicle goes straight on through to the end of the run where there may or may not be a layover before the return trip. Two periods of resting or sleeping in a berth in the truck meet the ICC requirement of 8 hours off duty following 10 hours of driving. This means that the drivers may remain with the truck in some cases for over 100 hours.

Although earnings on a sleeper run are the highest in this field of work, very few drivers stay with this type of run very long. The work is very tiring and requires being away from family and friends for days and even weeks. However, many drivers come back to sleeper runs after they have had a rest or done some relay driving for a while. The earnings of drivers of long-distance moving vans are also high, but their hours are long and the work is strenuous. They drive more miles than the average over-the-road driver and also work more hours in loading and unloading goods.

Largely due to intensive safety programs and drivers' skill, the accident rate in over-the-road trucking is surprisingly low. Injuries occur with less frequency than in other forms of motor transportation.

Driving the big over-the-road trucks does not involve the physical effort most people associate with truck driving. Sitting in one place for hours at a time, however, is tiring and the nervous strain of sustained driving at night is also fatiguing.

Most over-the-road drivers are members of the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.). Some drivers of private carriers belong to unions representing the plant employees of the company for which they work.

OCCUPATIONAL TRENDS IN THE UNITED STATES, 1900 TO 1950

A new publication, Occupational Trends in the United States, 1900 to 1950 (Bureau of the Census Working Paper No. 5), consisting mainly of statistical series on employment by occupation, has recently been issued by the Bureau of the Census. It brings up to date the Population Census special report prepared by Alba M. Edwards --Comparative Occupation Statistics in the United States, 1870-1940. The process of up-dating involved bringing together certain of the separate series developed by Dr. Edwards, preparing a number of new estimates to fill gaps, and adjusting the appropriate figures to conform to the definitions of the 1950 occupational classification system.

Counselors and others who are interested in the statistical details of occupational trends will find much useful data in this pamphlet.

The publication is for sale by the U. S. Bureau of the Census, Washington 25, D. C. Price 20 cents.

1958 STARTING SALARIES OF CHEMISTS AND CHEMICAL ENGINEERS

Starting salaries of most chemists and chemical engineers continued to rise in the last year, according to a survey conducted by the American Chemical Society in June-August 1958.[1] (See chart 1.)

Gains for chemists and chemical engineers were not as great from 1957 to 1958 as they were from 1956 to 1957. Starting salaries of inexperienced chemists with B.S. degrees, in fact, dropped slightly below 1957 figures--$430 compared with $435. (See table 1.) Salaries of women chemists declined; their median monthly starting salary dropped by 6 percent to $374, about the same as the 1956 figure. Men with B.S. degrees in chemistry and no experience, on the other hand, earned $440 in 1957 and again in 1958, thereby maintaining their status quo. Inexperienced chemists with M.S. or Ph.D. degrees recorded substantial salary gains in 1958 over 1957. (See table 1.) Those with master's degrees increased their median starting salary from $485 per month in 1957 to $511 in 1958, a 5.4-percent increase; doctors went from $650 to $675, an increase of 3.8 percent.

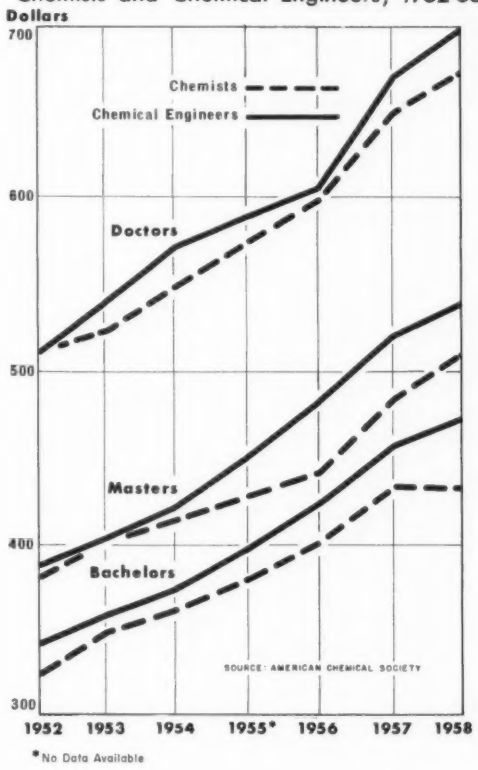
For inexperienced chemical engineers, increases in median monthly starting sal-

[1]This information was adapted from an article, Starting Salaries Still Rising, by David A. H. Roethel, which appeared in the American Chemical Society's publication, Chemical and Engineering News, October 20, 1958. The survey was carried out in June-August 1958, at which time 2,498 questionnaires were analyzed. It brings up-to-date salary information presented in the 1957 edition of the Occupational Outlook Handbook.

Table 1. Median monthly starting salaries of inexperienced chemistry graduates by college degree, 1957-58

College degree	1956	1957	1958	Percent change, 1957 to 1958
All bachelor's degrees	$400	$435	$430	-1.1
Men	407	440	440	0.0
Women	375	400	374	-6.5
Master's degrees	443	485	511	5.4
Doctor's degrees	600	650	675	3.8

Median Monthly Starting Salaries of Chemists and Chemical Engineers, 1952-58



aries were about the same for all degree levels, with a general gain of slightly better than 3 percent. (See table 2.) Engineers with B.S. degrees and no experience had median starting salaries of $475 per month in 1958 compared with $460 in 1957. Those engineers with bachelor's degrees completing the 5-year curriculum received higher starting pay (an average of $490) than those completing the 4-year curriculum. Salaries of chemical engineers with master's degrees and no experience rose from $525 in 1957 to $541 in 1958. Engineers with doctorates and no experience, continuing a previous trend, recorded a slightly greater percentage gain than those with less schooling--from $675 in 1957 to $700 in 1958, a 3.7-percent increase.

Experienced Graduates

Many persons who receive degrees in chemistry and chemical engineering have had some prior professional experience. For purposes of this survey, the American Chemical Society regarded persons with less than 25 weeks of professional experience as inexperienced. Thus, the graduates classified as experienced had all worked in the profession for 25 weeks or more--generally, either part time during the school year or for a succession of summers. Many employers regard this as significant experience and take cognizance of it when establishing salaries. (See table 3.) Experienced chemistry graduates, for example, earned median monthly starting salaries ranging from $20 to $39 more than graduates with no on-the-job training.

Differences in monthly starting salaries between experienced and inexperienced chemical engineering graduates varied more widely than those of chemists. In 1958 for the first time, experienced chemical engineers with Ph.D. degrees earned $50 a month more than inexperienced graduates, giving them a median starting salary of $750. It should be noted, however, that many of these graduates had lengthy experience, the median being 150 weeks. (See table 3.) Experienced engineers with M.S. degrees received median starting salaries of $560, a $19 per month advantage over their inexperienced classmates.

Effect of Geographic Location

Employment in the chemical profession is more heavily concentrated in certain areas of the country than in others,

Table 2. Median monthly starting salaries of inexperienced chemical engineering graduates by college degree, 1956-58

College degree	1956	1957	1958	Percent change, 1957 to 1958
All bachelor's degrees	([1])	$460	$475	3.3
4-year curriculum	$425	460	475	3.3
5-year curriculum	440	475	490	3.2
Master's degrees	485	525	541	3.0
Doctor's degrees	604	675	700	3.7

[1]Not available.

Table 3. Median monthly starting salaries of experienced graduates by college degree, 1958[1]

Salaries and experience	Bachelors	Masters	Doctors
	Chemists		
Salaries	$450	$550	$700
Median weeks of experience	52	104	104
	Chemical engineers		
Salaries	[2]$475	$560	$750
Median weeks of experience	[2] 48	52	150

[1]These graduates had worked in the profession 25 or more weeks before receiving their highest degree.
[2]4-year curriculum only.

Table 4. Median monthly starting salaries and distribution of chemical and chemical engineering graduates by region, 1958[1]

Region	B.S. chemists		Ph.D. chemists		B.S. chemical engineers	
	Salary	Percent in area	Salary	Percent in area	Salary	Percent in area
New England	$405	7.9	$675	11.2	$470	3.4
Middle Atlantic	433	26.3	683	27.9	475	26.1
South Atlantic	440	11.0	700	19.0	475	18.0
East North Central	430	21.1	650	17.4	475	20.9
East South Central	(2)	3.1	(2)	2.6	475	3.4
West North Central	428	6.1	(2)	4.2	480	7.0
West South Central	460	10.1	670	10.0	475	10.6
Mountain	(2)	2.6	(2)	2.1	(2)	1.4
Pacific	450	11.8	675	12.7	470	9.4

[1]New England--Maine, N.H., Vt., Mass., R.I., Conn.; Middle Atlantic--N.Y., N.J., Pa.; East North Central--Ohio, Ind., Ill., Mich., Wis.; West North Central--Minn., Iowa, Mo., N. Dak., S. Dak., Nebr., Kans.; South Atlantic--Del., Md., D.C., Va., W. Va., N.C., S.C., Ga., Fla.; East South Central--Ky., Tenn., Ala., Miss.; West South Central--Ark., La., Okla., Tex.; Mountain--Mont., Idaho, Wyo., Colo., N. Mex., Ariz., Utah, Nev.; Pacific--Wash., Oreg., Calif.

[2]Not available.

which places the graduate in the position of balancing salary against location and consideration of personal preferences. For some, this is an important decision. Consider the case of the inexperienced B.S. chemist in 1958. According to the survey, if he took a job in West South Central or Pacific regions of the United States, he probably earned from $45 to $55, respectively, more than a person with the same training who went to work in New England. (See table 4.)

Effect of Type of Employer

Differences between academic and industrial salaries were considerable in 1958, as in previous years. (See table 5.) The teaching profession, which had a continued need for Ph.D. graduates in chemistry in 1958, paid them a median starting salary of $500 a month. In industry, by comparison, the median salary was $700--a 40-percent difference. This was a continuation of the salary differential observed from surveys conducted in previous years.

The survey findings regarding salaries of inexperienced chemists and chemical engineers with B.S. degrees, who entered government employment in 1958, were difficult to evaluate for several reasons. First, early in 1958, the Federal Government authorized in-grade raises to certain job classifications in the hard-to-hire category. Then a general pay increase was given to all Federal employees in June 1958. Furthermore, the median starting salaries calulated from the ACS survey also included reports from employees of city and State governments. Hence, the monthly salaries reported in the survey--$375 for chemists and $410 for chemical engineers entering government employment--may understate their current salaries. (Actually Federal Government starting salaries for some highly qualified chem-

Table 5. Median monthly starting salaries of inexperienced chemistry graduates in academic and industrial positions by college degree, 1958

College degree	Academic	Industrial
Bachelor's degree	$365	$450
Master's degree	444	525
Doctor's degree	500	700

ical engineering and chemistry graduates in late 1958 were as high as $4,980 per year, or approximately $415 per month.)

Starting salaries of chemists with B. S. degrees varied widely from industry to industry. (See table 6.) For example, those who took jobs with biological and pharmaceutical firms had median starting salaries of $400 per month. Those entering the petroleum industry, however, reported salaries of $465 per month. Other high-paying industries for chemists were chemicals and plastics. Salaries of inexperienced chemical engineers with bachelor's degrees showed little deviation from the all-industry median of $475.

Table 6. Median monthly starting salary of inexperienced chemistry and chemical engineering graduates with B. S. degrees, by industrial employer classification, 1958

Industry	Chemists	Chemical engineers[1]
Biological and pharmaceutical	$400	$475
Chemical	450	480
Food	420	470
Machinery and equipment	[2]	470
Metals (including steel)	[2]	486
Paper	[2]	470
Petroleum	465	475
Plastics	450	475
Rubber	[2]	470
Other	433	475

[1] 4-year curriculum only.
[2] Insufficient data to calculate medians. Data from paint, textile, and transportation industries were also inadequate.

Summer and Part-Time Employment

The ACS survey also obtained some information on graduates who had worked at temporary summer jobs. For bachelors in chemistry and chemical engineering, median summer salaries of $400 and $435 per month, respectively, were recorded in 1958--somewhat less than in 1957. Chemists with master's degrees reported summer earnings of $485 a month--a gain of $10 over 1957, while chemical engineers with the M. S. degrees reported $490, the same as in 1957.

Pay for graduate students in chemistry who worked part time was just about the same as in 1957. Candidates for both the M. A. and Ph. D. degrees reported $175 per month. Last year, chemical engineers with bachelor's degrees earned $170; this year they earned only $160. Conversely, masters in chemical engineering reported $200 this year and $170 last year. An interesting observation is that graduate assistants in chemistry with the bachelor's degree appeared to be earning more money in 1958 than chemical engineers with bachelor's degrees who were working as graduate assistants.

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